

having ceased to develop at an early stage, and being remodelled after the fashion of the dipterous larvæ which we have been discussing, might have acquired the power of pædogenic reproduction. I readily admit that our hypotheses are somewhat many in number; but there is not a single one among them which has not been actually observed in the Arthropod phylum itself, and more frequently in combinations. Whether the leg-stumps of the Tardigrades have arisen by degeneration from Arthropod appendages of their ancestors, or whether they may be new formations like the pro-legs and claspers of the caterpillars, is a question which is difficult to decide. Its solution, however, be it as it may, needs to alter nothing in the whole conception.

If we once more briefly sum up the points of agreement between the Tardigrades and greatly modified Tracheate larvæ, somewhat of the type of the maggots of *Cecidomyia*, we find:—absence of a head, chitinous stylets in the œsophageal tube, absence of any ciliated epithelium and of a dermal muscle-sheath, musculature broken up into isolated cords, supra-œsophageal ganglion and ventral ganglion-chain, simple structure of the sexual organs, and, lastly, Malpighian vessels. The differences depend upon further advanced degeneration of the Tardigrades, and include:—small number of the ganglia (disappearance of the parts of the subœsophageal ganglion), smooth musculature, absence of tracheæ and circulatory organs, and the probable reduction of the one germ-gland. As new formations we may perhaps regard the efferent duct of the sexual organs and, at any rate, the leg-stumps, if these are not an ancestral character.

Embryology as yet affords us no explanation; besides the development need no longer be of the typical Arthropod type, but may have secondarily undergone great modifications.

XXX.—On some newly-described Jurassic and Cretaceous Lizards and Rhynchocephalians. By G. A. BOULENGER.

IN a paper published two years ago (2), whilst dealing with a few points in the osteology of *Heloderma* and the systematic position of that genus of lizards, I ventured to express some views on the probable phylogeny of the order Squamata, which comprises the existing group of true lizards, chameleons, and snakes. I pointed out that the Cretaceous lizard *Hydrosaurus lesinensis*, regarded by some authors as a member

of the family Varanidæ, agreed, so far as could be judged from the figures published by Kornhuber, with Owen's *Dolichosaurus*, and that the suborder Dolichosauria might prove to be the ancestral group from which the Lacertilia, Pythonomorpha, and Ophidia evolved. This opinion was founded on the archaic condition of the hind limbs and the number of cervical vertebræ; the presence of the zygosphenal articulation of the vertebræ, present in all Ophidia and several Lacertilia and Pythonomorpha, lent additional support to this hypothesis.

As I expected, my views have not had the approval of Dr. Baur, who, in a lately published paper on the skull of Mosasaurs (1), adheres to his previously expressed opinion that the Varanidæ, Mosasauridæ, and Helodermatidæ should be grouped together as a suborder "Platynota."

With regard to the structure of the foot, he denies any considerable difference between Kornhuber's *Hydrosaurus lesinensis*, which I referred to the Dolichosauria, and a true *Varanus*. But unless he contests the correctness of Kornhuber's restoration of the metatarsals and propodials, his statement does not refute my interpretation; the figures which I have reproduced (after Marsh and Kornhuber) speak for themselves. On the other hand, when he says that he has "no hesitation to assume that unguiculated limbs can be transformed into paddles with numerous phalanges," I entirely agree with him, and do not know that I have ever expressed any opinion to the contrary.

His other argument is that there is no evidence for the supposition that the number of cervical vertebræ after having increased in the Dolichosauria can have become gradually reduced again until the Rhiptoglossan number five was reached. If my critic admits, as I believe he does, that the Rhynchocephalia are descended from the Stegocephala, which have fewer than eight cervical vertebræ, and that the Rhiptoglossa are only an ultra-specialized branch of the typical Lacertilia, he cannot well argue against the probability of such a process of increase followed again by a reduction. In fact, if he will refer to one of his previous contributions to the phylogeny of the Reptilia, he will find that he has no difficulty in assuming that the Chelonians, with eight cervicals, may have been descended from Plesiosaurians with very numerous cervicals, the latter having been, as he himself admits, derived from short-necked forms. That he now holds "All forms which show a greater or smaller number of cervicals [to] have with very little doubt developed from forms with eight cervicals" shows that his views have undergone a

considerable change since 1887, when, commenting on Parker's discovery of at least fifteen somatomes in the cervical region of the embryo of *Chelone*, he regards the latter author's statement, that "This free suppression of segments suggests a great secular modification by shortening of a form not unlike a Plesiosaur," as a "proof of the affinity of the Testudinata and Sauropterygia." What Dr. Baur proves with so much assurance on one occasion he himself pretends to disprove on the next, without even referring to the position he has previously taken up.

Two recently published contributions throw fresh light on the Jurassic and Cretaceous Squamata, and suggest some further remarks on the subject.

The first of these contributions is a paper by Gorjanović-Kramberger (5), who, ignoring my previously published note and reasoning from a different point of view, arrives at results very similar to mine in dealing with the systematic position of some Cretaceous lizards from Dalmatia.

He describes a new form, *Aigialosaurus*, which shows points of affinity to the Dolichosauria, the Pythonomorpha, and the Varanoid Lacertilia, and proposes to establish a group named Ophiosauria to comprise the Aigialosauridæ and Dolichosauridæ. It is needless to observe that the term Ophiosauria must be superseded by that of Dolichosauria, which is of older standing, although Kramberger appears to be ignorant of its existence. His definition of the group is, besides, deficient in truly diagnostic characters.

The *Hydrosaurus lesinensis* of Kornhuber is incidentally dealt with, and the genus *Pontosaurus* is established for it in the family Aigialosauridæ, which is stated to be distinguished from the Dolichosauridæ by the number, 7 to 9, of cervical vertebræ. However, it seems clear to me, after reexamination of the figure given by Kornhuber, that *H. lesinensis* possessed about 15 cervical vertebræ, and I am still at a loss to find how it is to be generically distinguished from *Dolichosaurus*. But this is a matter which cannot well be dealt with without comparing the specimens themselves; therefore the genus *Pontosaurus* may be accepted provisionally, provided it be not identical with *Acteosaurus* of H. v. Meyer or *Adriosaurus* of Seeley.

Aigialosaurus, of which the figure of a nearly perfect specimen is given, is a remarkable lizard, with somewhat the physiognomy of a Monitor or *Varanus*, but with the jugal in contact with the postfrontal and closing the orbit behind, shorter and stouter ribs, and limbs much of the same type as in *Pontosaurus*, although more developed. The quadrate is

shown to differ considerably from that of the Varanidæ and to agree very closely with that of Mosasaurs. Kramberger is therefore fully justified in regarding this type as one of the original stock from which the Varanoids and the Mosasaurs were derived.

There are a few points in Kramberger's description which need criticism. First, as regards the number of cervical vertebræ: whilst admitting that, owing to the sternum not being preserved, it is difficult to decide which is the first dorsal vertebra (taking as such that which bears the first sternal rib), the author assumes that only seven vertebræ are to be reckoned as cervicals, his reason being that the scapula in his specimen is situated on a line with the fifth to seventh vertebræ. In a specimen of *Varanus niloticus* which I have before me I find that the scapula corresponds to the sixth and seventh vertebræ, and yet nine cervicals exist; besides, the last cervical is a little shorter than the first dorsal, the difference between the two being about the same as represented in *d. 2* and *d. 3* of Kramberger's figure. I would therefore say that *Aigialosaurus* had nine cervical vertebræ, or even ten in the event of the atlas having been overlooked.

A second criticism I have to make is with respect to the importance attached by Kramberger to the great development of the cervical autogenous hypapophyses of his reptile as differentiating it from existing lizards; for on the five anterior vertebræ of the Agamoid *Physignathus Lesueurii* I find them quite as long as in *Aigialosaurus*, and other recent lizards approach this condition.

An interesting point in the specimen figured is the presence, to which, however, no allusion is made in the text, of double parapophyses to the second sacral and the first two caudal vertebræ, thus representing the well-known "lymphapophyses" of snakes. On this occasion I would remark that Dollo, in a recent contribution, is entirely mistaken when he thinks that the lymphapophyses of snakes and apodal lizards represent the combined ribs and hæmapophyses. A glance at the skeleton of a viper, to mention no other examples, shows that the lymphapophyses may coexist with the paired hypapophyses on one and the same vertebra. His statement, "les lymphapophyses ne coexistent jamais sur la même vertèbre, soit avec les côtes, soit avec les hæmapophyses," is therefore erroneous; and his deductions, so far as this point is concerned, consequently fall to the ground.

We have so long been ignorant of any undoubted pre-Tertiary Lacertilian in the restricted sense, that much importance attaches to the description of the Upper Jurassic

Euposaurus Thiollierii, Lortet, which has just appeared in Dr. Lortet's splendidly illustrated memoir on the fossil reptiles of the Rhone Basin (6). Although the fossil is unaccountably referred to the Rhynchocephalia, and even to the family Sphenodontidæ, which, in the French author's classification, includes *Homæosaurus*, there can be no doubt that we have here to do with a true lizard, as is evidenced by the absence of a quadrato-jugal arch and of a plastron. The pleurodont dentition, the absence of supra-temporal fossæ, the non-dilatation of the clavicles, are characters which approximate *Euposaurus* to the Anguidæ. The interclavicle ("sternum" of Lortet) is unfortunately not preserved. A curious oversight is noticeable in the description of this lizard, the fifth toe being described as the hallux, which is thus stated to be opposable to the other digits, whereas in reality the pes does not differ from that of an ordinary lizard.

Of still greater interest is Lortet's account and figure of *Pleurosaurus Goldfussii*, H. v. Meyer, likewise referred to the Sphenodontidæ. It is, however, quite clear that the cranial characters are not Rhynchocephalian. The temporal arch appears to be essentially of a Lacertilian type and to correspond with what is found in the Agamidæ. But the structure of the limbs is primitive, agreeing in the tibia and ulna and the metatarsals with the Dolichosauria and Proterosauria; and as the specimens described by H. v. Meyer show a plastron in the form of fine riblets, which are, however, not preserved in Lortet's specimen, *Pleurosaurus* should be regarded as the type of a distinct order of reptiles, combining characters of the Proterosaurian Rhynchocephalia and Squamata, for which the name Acrosauria, proposed by H. v. Meyer in 1860, may be used.

The number of cervical vertebræ in *Pleurosaurus* is stated by Lortet to be only five. I have to repeat the criticism made above respecting Kramberger's *Aigialosaurus*, and to add that the first rib-bearing vertebra does not represent the atlas; this vertebra is not even entirely concealed in Lortet's specimen. Two small bones visible behind the occiput are, in my opinion, the neuroids of the atlas. By further adding to the neck the two vertebræ named by Lortet first and second dorsal we have eight cervicals instead of five.

Dr. Lortet's memoir is also rich in information respecting the Rhynchocephalian genera *Homæosaurus* and *Sauranodon* (which name must yield to the prior *Saphæosaurus*). The latter genus was very imperfectly known; but the beautiful figures and the detailed description now published leave little to desire, although some important characters shown by the

figures are not alluded to in the text. A new family, Sauranodontes, is established by Dr. Lortet for its reception, and is chiefly founded on the total absence of teeth and the pro-cœlous vertebræ. In dealing with the latter character the author curiously contradicts himself, for in the definition of the family (p. 29) the vertebral centra are stated to be concave behind, whilst further on (p. 53) the reverse is described. That the latter statement is the correct one is shown by the figures on pl. iii. The skull, as in the Rhynchosauridæ, has no parietal foramen, and the bones described as the posterior portions of the parietals appear to be the supra-temporals, distinct from the squamosals.

The position of this new family in the system is indicated in the following revised scheme of the classification proposed by me in 1891 (3). The Champsosauridæ, first included in the Rhynchocephalia vera, are now shifted to the Proterosauria, in accordance with the recent researches of Dollo (4), who has shown these reptiles to be related to *Proterosaurus*.

Order **RHYNCHOCEPHALIA.**

Suborder I. PROTEROSAURIA.

Each transverse segment of the plastron composed of numerous paired pieces. Pubis and ischium plate-like. Fifth metatarsal not modified.

A. Nasal openings distinct.

Vertebræ conically excavated at either end, with persistent notochord, all with intervertebral hypapophyses; limb-bones without condyles; humerus with entepicondylar foramen..... 1. PALÆOHATTERIIDÆ.

Vertebræ fully ossified, cervicals opisthocœlous, dorsals biconcave; no hypapophyses between the dorsal vertebræ; limb-bones with condyles; humerus with ectepicondylar foramen or groove..... 2. PROTEROSAURIDÆ.

B. Nasal opening single; vertebræ fully ossified, feebly biconcave; no hypapophyses between the dorsal vertebræ; humerus with ectepicondylar groove .. 3. CHAMPSOSAURIDÆ.

Suborder II. RHYNCHOCEPHALIA VERA.

Each transverse segment of the plastron composed of three pieces, a median angulate and a pair of lateral. Pubis and ischium elongate and fifth metatarsal modified, as in the Lacertilia.

A. Jaws toothed; vertebræ amphicœlous.

α. Nasal openings distinct; mandible with coronoid process, the rami not united by suture. Vertebræ deeply biconcave.

- Humerus with ectepicondylar and entepicondylar foramen; ribs with uncinatè processes; all the vertebræ with intercentral hypapophyses 4. HATTERIIDÆ.
- Humerus with entepicondylar foramen; ribs without uncinatè processes; no hypapophyses between the dorsal vertebræ..... 5. HOMŒOSAURIDÆ.
- b. Nasal opening single. Mandible without coronoid process, the rami united in a solid symphysis; vertebræ feebly biconcave; no hypapophyses between the dorsal vertebræ. Humerus with ectepicondylar foramen or groove 6. RHYNCHOSAURIDÆ.
- B. Jaws toothless. Vertebræ procœlous. Mandible without coronoid process, the rami united in a solid symphysis. Humerus with ectepicondylar foramen 7. SAURANODONTIDÆ.

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XXXI.—*On some new or rare Scottish Entomostraca.* By THOMAS SCOTT, F.L.S., Naturalist to the Fishery Board for Scotland, and ANDREW SCOTT.

[Plates VII. & VIII.]

PARARTOTROGUS, gen. nov. (provisional name).

Anterior and posterior antennæ and mouth-organs as in *Artotrogus*, Boeck, except that the siphon is rudimentary. First pair of swimming-feet with both branches two-jointed;